

REMARKS

Applicants gratefully acknowledge Examiner Baumeister for taking time from his busy schedule to conduct a personal interview on November 18, 2003, with Applicants' representative. Applicants believe that this interview has advanced prosecution by permitting an exchange of viewpoints. Applicants also wish to acknowledge the Examiner's very rapid and professional response to the Request for Reconsideration Under 37 CFR 1.116, filed on October 31, 2003.

During discussion in that interview, it was mentioned that Applicants were unable to find in Nakamura '307 and '350 a suggestion that the barrier and n-clad layers be "substantially the same material". Based on the rejection of record and the contents of the Advisory Action mailed November 24, 2003, Applicants hereinbelow more specifically clarify their position as to why both Nakamura references provide, at most, merely the possibility of arriving at the present invention, and would have to be modified to reach the present invention.

Claims 1 and 4-31 are all of the claims pending in the present Application. New claims 18-31 are added to better highlight a key aspect of the present invention as being combinations of elements not previously recognized in the art as being significant.

That is, Applicants submit that a key aspect of the present invention is that it includes a combination of elements that provide an LED having an enhanced color purity. Applicants further submit that the parameters discussed in the present Application have not been recognized in the art as significant to providing color purity, let alone a recognition of the details and narrow ranges described in the present Application.

Attached hereto is an Excess Claims Fee letter and fee.

It is noted that, notwithstanding any claim amendments made herein, Applicant's intent is to encompass equivalents of all claim elements, even if amended herein or later during prosecution.

Claims 1, 4-6, 15, and 16 stand rejected under 35 USC §102(e) as anticipated by US Patent 5,959,307 to Nakamura et al. Claims 9 and 17 stand rejected under 35 USC §102(b) as anticipated by US Patent 5,777,350 to Nakamura et al. Claims 7, 8, and 10-14 stand rejected under 35 USC §102(e) as anticipated by or, in the alternative, under 35 USC §103(a) as

unpatentable over US Patent 5,959,307 to Nakamura et al.

These rejections are respectfully traversed in view of the following discussion.

I. The Claimed Invention

As described and claimed, for example by claim 1, the present invention is directed to a group III nitride compound semiconductor light-emitting device including a light-emitting layer of a multilayer quantum well structure including alternately laminated well layers and barrier layers and an n-type clad layer being in contact with the light-emitting layer. The n-type clad layer is made thicker than each of the barrier layers and the thickness of the n-type clad layer is in a range of 100 Å to 500 Å. The n-type clad layer is formed of a material substantially the same as the barrier layers, by reason of having been formed in substantially same conditions.

With such unique and unobvious features, high light intensity is provided by securing the effect of confining carriers sufficiently in the light-emitting layer while keeping color purity intact.

II. The Prior Art Rejections

The Rejection based on Nakamura '307

The Examiner continues to allege that Nakamura '307 anticipates claims 1, 4-6, 15, and 16 and either anticipates or renders obvious claims 7, 8, and 10-14.

However, Applicants submit that, the specific lines in this reference upon which the Examiner seems to rely do not reasonably justify this position that "substantially the same material" is used for both the n-clad layer and the barrier layer, as follows:

1. On page 3 of the Office Action dated November 24, 2003, in paragraph 2.a., the Examiner states:

"... this disclosure means that the tunnel/clad necessarily may have a bandgap that is either less than, equal to, or greater than the bandgap of the barrier. This, in turn, is another way of saying that the tunnel/clad layer composition may possess relative to the barrier, either (1) a different composition with more indium than does the barrier, (2) the

same composition (either InGa_{1-f}N or GaN), or (3) a different composition with more aluminum than does the barrier (the barrier would still have no Al). Thus, contrary to the Applicant's position, it is Nakamura '307 -- not the Examiner -- that discloses that the tunnel/clad and the barrier may be formed of substantially the same materials. Therefore, the claims are anticipated." (Emphasis by Applicants)

Applicants again submit that the above statement clearly reflects a position that Nakamura '307 teaches, at most, a structure that leaves open the possibility that it could be modified in accordance to the concepts of the present invention, including the feature that the barrier layer and the n-clad layer be substantially the same material. This possibility of modification is not anticipation.

Anticipation requires that all limitations be taught (or inherent) in the reference. Nakamura '307 does not teach or suggest using the same material for the barrier layer and the n-clad layer.

As Applicants have explained, the significance of using the same material for the barrier and the n-clad layer is that the strain on the light emission layer is eliminated, thereby enhancing color purity. This aspect of the present invention has not been recognized in the prior art.

Hence, turning to the clear language of the claims, there is no teaching or suggestion in Nakamura '307 of: "... wherein said n-type clad layer is formed of a material substantially the same as said barrier layers, by reason of having been formed in substantially same conditions", as required by claim 1. Independent claim 15 and new claim 18 have similar language.

2. On page 4 of the Office Action, in paragraph 2.c., the Examiner points to lines 25-30 of column 6 of Nakamura '307.

However, Applicants submit that these lines describe a barrier layer of:

"... GaN, AlGa_{1-f}N or the like", but continues on to say that "... it is particularly preferred that the barrier layer be formed of a ternary mixed crystal In_fGa_{1-f}N (0 < f < 1 providing f' < f) as in the case of the well layer. If the active layer 16 takes an MQW structure made by laminating InGa_{1-f}N layers having different band gap energy, a high-output power LD device can be realized" (Emphasis by Applicants).

As best understood, the rationale (e.g., the teaching) in Nakamura '307 is that the well and the barrier layers should both be ternary mixed crystal materials (e.g., In_fGa_{1-f}N (0 < f < 1 providing f' < f)).

Applicants submit that these lines would, therefore, clearly teach against using GaN for the barrier and, therefore, clearly teach against using GaN for both the barrier and the n-clad layer.

Hence, turning to the clear language of the claims, in Nakamura '307 there is no teaching or suggestion of: "... wherein said n-type clad layer and said barrier layers are formed of GaN", as required by claim 7. Claims 16 and 19 have similar language.

The Rejection based on Nakamura '350

The Examiner also maintains the position that Nakamura '350 anticipates claims 9 and 17. Applicants submit that this reference fails to teach expressly the use of the same material (e.g., GaN) for both the n-clad layer and the barrier layer, as follows:

1. First, the Examiner relies upon line 7 of column 5. This line states that the "... first n-type clad layer made of ... or of an n-type GaN."

Clearly, this line does teach that GaN is a material potentially to be used for the n-clad layer. But, this line clearly does not teach or suggest that the n-clad layer material be substantially the same as the barrier layer material.

2. Second, the Examiner points to lines 10-20 of column 7, wherein is stated:

"The n-type clad layer 13 may be formed If it is formed of a binary or ternary mixed crystal such as GaN, AlGaIn or InGaIn, a clad layer of excellent crystallinity can be obtained. If the n-type clad layer 13 is formed of InGaIn or GaN in particular, the formation of relatively thin active layer 14 can be made possible,"

Clearly, again, these lines teach that InGaIn or GaN are materials potentially to be used for n-type clad layer 13, but it does not teach or suggest that the n-type clad layer be substantially the same as the barrier layer material.

3. Third, the Examiner further points to column 19, beginning at line 62. As best understood, the Examiner is pointing to the seventh embodiment, wherein GaN is indeed listed as material for the n-clad layer 155. However, this embodiment contains only a single layer 156 for the active layer.

Therefore, this seventh embodiment does not have a barrier/well structure, and it cannot reasonably be asserted that this embodiment teaches or suggests using GaN for both the n-clad layer 155 and a barrier layer. That is, it must be recognized that each embodiment

and example in Nakamura is a unique combination of elements. It would be improper to merely "cut and paste" together various elements from various embodiments or examples.

4. The Examiner also points to claim 8 of Nakamura '350. As best understood, since this claim clearly does not define a barrier layer, let alone a barrier layer that is substantially the same material as "... the first n-type clad layer comprising an n-type nitride semiconductor not containing aluminum", the Examiner would again seem to be improperly relying upon mere possibility.

Therefore, claim 8 clearly does not describe a barrier/well structure, and it cannot reasonably be asserted that this claim addresses using substantially the same material for both the first n-clad layer and a barrier layer.

5. Finally, the Examiner is understood as relying upon Example 13 of Nakamura '350, as described in column 39.

However, Applicants submit that this example merely confirms that the prior art has failed to recognize the significance of "substantially the same material for both the barrier layer and the n-clad". That is, as pointed out by the Examiner, this example is indeed "close to" the concept of the present invention in which "substantially the same material" is used (e.g., in Example 13, the n-clad layer is $\text{In}_{0.01}\text{Ga}_{0.99}\text{N}$ and the barrier layer is $\text{In}_{0.02}\text{Ga}_{0.98}\text{N}$).

However, it is clear that Nakamura '350 does, indeed, have two different layers. This difference, considered by the Examiner as a small compositional difference, clearly establishes that Nakamura '350 does not at all suggest using "substantially the same materials" (e.g., this 1% difference is significant to one of skill in the art) and that using the same material for both layers was not common in the art as of the time of the present invention. That is, it clearly would have been easier for Nakamura '350 to use essentially identical mixtures for both layers, rather than modifying the composition for each layer.

Therefore, it cannot reasonably be concluded that Nakamura '350 teaches or suggests that the n-clad layer material be substantially the same as the barrier layer material. Indeed, Nakamura '350 more reasonably stands for the teaching that it was considered that there must be a benefit for maintaining a difference between these two layers.

That is, in spite of the Examiner's contrary viewpoint, Applicants respectfully submit that Example 13 of Nakamura '350 clearly teaches against using "substantially the same

material" and clearly represents a confirmation that the prior art more reasonably considers that a benefit exists for maintaining a difference in composition and was unaware of the significance of using "substantially the same" materials, as taught in the present invention.

The Examiner is also understood as relying upon Nakamura '350 as anticipating claims 9 and 17.

To anticipate claim 9, Nakamura must expressly teach a cap layer between a p-clad layer and the light emission layer that is "substantially the same material" as used in the barrier layer of the emission layer, as well as the n-clad layer.

As best understood, the Examiner relies upon first p-clad layer 61 as equivalent in Nakamura '350 for the cap layer of claims 9 and 17, and points to lines 20-25 of column 8.

However, at lines 4-5 of column 8, Nakamura '350 expressly teaches:

"This first p-type clad layer 61 is formed of a p-type nitride semiconductor containing Al and Ga, and most preferably is formed of a ternary mixed crystal of AlGaIn.... On the other hand, if the first p-type clad layer is formed of a p-type GaN, the emission output will be decreased to 1/3 of the case where the p-type AlGaIn is employed. The reason of this phenomenon may be ascribed to the facts that GaN is less likely to be turned into p-type as compared with AlGaIn and that GaN is more likely to be decomposed during the growth thereof, deteriorating the crystallinity thereof: but details are not clear yet." (Emphasis by Applicants)

Applicants respectfully submit that the above lines does indeed teach against using GaN as the cap material and that there is no suggestion whatsoever in these lines or anywhere else in Nakamura '350 that the cap material be "substantially the same" as both the barrier layer and the n-clad layer.

Therefore, Applicants respectfully submit that Nakamura '350 cannot reasonably be described as anticipating this feature of the present invention.

Hence, turning to the language of the claim, in Nakamura '350 there is no teaching or suggestion of : "... a cap layer formed on said light-emitting layer, said cap layer being formed of a material substantially the same as said barrier layers".

For the reasons stated above, the claimed invention is fully patentable over the cited references Nakamura '307 and '350.

Further, the other prior art of record has been reviewed, but it too even in combination

with the two Nakamura references, fails to teach or suggest the claimed invention.

Moreover, as previously pointed out, the claims additionally incorporate a number of very limited ranges of layer compositions and thicknesses. The reason for these additional limitations is not, as the Examiner seems to interpret, that these additional limitations are insignificant elements that are included in the broad ranges recited in Nakamura, but rather, that these narrow ranges have been discovered to respectively contribute a new dimension of an overall approach to an LED structure that provides enhanced color purity and an improved intensity for the specific emission wavelength.

Applicants have added new claims 18-31 to further highlight this aspect that the present invention is a new combination of elements that provide enhanced color purity and intensity for a predetermined wavelength. Although the claimed combinations arguably might be possible, if Nakamura '307 and '350 were to be further modified as described by the concepts of the present Application, Applicants respectfully submit that neither Nakamura reference reasonably suggests the techniques and design details of the present invention.

Relative to new claims 30 and 31, it is noted that the second clad layer 124, 134, 154, 214, 314 in Figures 9-16 of Nakamura '350 incorporates AlGaN to enhance the carrier confining effect. Applicants consider that this is a key feature in Nakamura '350.

However, relative to this composition, the existence of Al would cause adverse effect to the color purity, since Al has a large bandgap.

In contrast, the present invention teaches a number of techniques, including those defined in claims 30 and 31, that work together to enhance color purity and that provide optimal intensity at the predetermined color wavelength.

III. Formal matters and Conclusion

In view of the foregoing, Applicant submits that claims 1 and 4-31, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance,

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15

the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: _____

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